Mars Technology Program

The Mars Technology Program (MTP) is part of the NASA Mars Exploration Program (MEP). The purpose of MTP is to develop technologies needed for future Mars missions, including Mars Scouts.

The two principle program elements of MTP are the Focused Technology and the Base Technology Programs. The Focused Technology Program addresses technologies that are specific and critical to near-term missions, while the Base Technology Program addresses those technologies that are applicable for multiple missions and which can be characterized as longer term, higher risk, and high payoff technologies.

Focused Technology Program

Currently, the MTP Focused Technology Program is providing time-critical deliverables for infusion into the 2009 Mars Science Laboratory (MSL) mission. Critical technologies for this mission are: Entry, Descent, and Landing (EDL), Long-Life systems, Robust Software for MSL rover, Rover Navigation and Instrument Placement, Sample Acquisition, Handling, and Processing, Planetary Protection, and Mars Proximity Telecom. These technologies can be summarized as follows:

- **EDL** technology will provide precision landing (<10km landing error) and deliver a large payload (900-1100 kg) safely onto the Martian surface. These technologies are developed in the specialty areas of optical navigation, guided entry, subsonic parachute, descent propulsion, hazard detection and avoidance, and robust landing.

- **Long-life systems** capability addresses both the electronic and mechanical elements of MSL. The included elements are: actuator assembly for rover wheels and robotic arms, advanced mechanical pumped cooling loop to recycle waste heat from radioisotope power sources, and lightweight wheel/differential. Long-life surface system components are designed to operate for 1+ Mars year in Mars ambient.

- **Robust software** for the MSL rover is developed by employing MDS-based software architecture and systems engineering methodology. Validation of this software technology involves both the MTP research rover platforms and simulated virtual rovers. The MDS architecture provides a unified framework and reusable software components for flight/ground software.

- **Rover navigation and instrument placement** provides advanced navigation and approach-and-place capability. This capability allows the MSL rover to extend its mobility range beyond 5km and achieve single-sol target approach and instrument placement.

- **Sample acquisition, handling, and processing** includes technologies that enable the extraction of samples from the environment (coring/abrading), transfer of those samples to a sample processing unit (robotic arm controls), and processing of the samples for delivery to the on-board science instruments (rock crushing and sample distribution).

- **Planetary Protection** addresses biological contamination control technologies for meeting the planetary protection requirements for MSL. This includes the deployment of a rapid validation method for enumerating spores (4 hours instead of 3 days) and cleaning/maintenance methods for achieving organic cleanliness (10^{-9} g/cm^2) of the MSL sample handling/analysis chain.

- **Mars proximity telecom** (aka the Electra Payload) provides a radiation tolerant/hardened, reconfigurable wireless network node to enable enhanced telecom and navigation capability for all future Mars missions. This payload will be flown on the Mars Reconnaissance Orbiter (MRO) mission to validate the technology before it is used on MSL.

Base Technology Program

The core of the Base Technology Program is breakthrough technology elements that are not in the critical path of specific missions. Technologies that can enhance baseline missions as well as new, enabling technologies for future missions are addressed, including:

- **Regional Mobility and Subsurface Access** which involves innovations in autonomous surface vehicles (rovers), aerial platforms such as balloons and airplanes, subsurface access with drills and other robotic devices, and science operations.

- **Science Instruments and Systems** including the development of both remote and in situ instrumentation for addressing scientific objectives, with a focus on the development of new techniques for in situ life detection.

- **Telecom and Navigation** technology investments which are focused on Mars-specific needs. Specifically these are related to proximity link relay communications and in situ radio-based navigation scenarios. Relay communications technologies that are aimed at significantly increasing science data return from a wide range of future exploration assets (e.g., landers, rovers, aerobots, microprobes) while minimizing mass, volume, and energy needs. Next-generation network protocols that will ensure interoperability while enabling efficient operations. Additionally, extraction of radiometric information from these proximity links can support precision in situ navigation for scenarios such as approach, surface mobility, and on-orbit rendezvous.

- **Advanced Entry, Descent, and Landing Technologies** focused on third generation capabilities in entry, descent, and landing, and providing pinpoint landing accuracy through advances in navigation, guidance, and sensors.

- **Mars Sample Return Technologies** including innovative technologies that may provide new capabilities to enable Mars Sample Return missions while substantially reducing the cost. This includes new technologies that can enhance the performance of the Mars Ascent Vehicle (MAV) by reducing power, mass, and volume, and increasing the accuracy with which samples are injected into Mars orbit. Other technologies include innovative techniques to satisfy the forward and back planetary protection requirements by less expensive methods than currently available. This technology area will also address the development of technologies for the Mars orbit sample rendezvous and capture.

- **Scout Mission Technologies** which include those technologies that will enable future (post 2007) Scout missions. The approach here is to solicit ideas from the Scout community for technologies that are deemed enabling for a wide variety of future Scout missions. MTP will competitively select those technologies that will have the highest payoff for future Scout missions. Technologies developed under this program will be available to the community and may benefit future Scout and baseline missions.